CHEHALIS RIVER RIVERSIDE BRIDGE **HAER No. WA-111**
State Route 6 spanning the Chehalis River
Chehalis vicinity
Lewis County
Washington

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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

PHOTOGRAPHS

HISTORIC AMERICAN ENGINEERING RECORD
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CHEHALIS RIVER RIVERSIDE BRIDGE

HAER No. WA-111

Location:	State Route 6, spanning the Chehalis River, Chehalis Vicinity, Lewis County, Washington, beginning at mile point 50.94. UTM: 10/501060/5166860 10/501380/5167040 Quad: Centralia, Wash.
Date of Construction:	1939
Engineer:	Washington Department of Highways
Fabricator:	Angeles Gravel and Supply Company, Port Angeles, Washington
Owner:	Originally Washington Department of Highways. From 1977, Washington State Department of Transportation, Olympia, Washington
Present Use:	Vehicular and pedestrian traffic.
Significance:	The Chehalis River Riverside Bridge is a riveted Warren through truss with verticals. It was built to the new 240′ standard bridge design devised by the Washington Department of Highways which superseded its earlier standard plan.
Historian:	Jonathan Clarke, August 1993.

History of the Bridge

In the 25 March 1939 issue of the *Pacific Builder and Engineer* notice first appeared of the state of Washington's intention to build a bridge across the Chehalis River, for an estimated cost of $250,000.[1] The work was to also include the grading and surfacing of the approach roads. Bids were opened in July of that year, and on the 11 July the contract was let to the Angeles Gravel and Supply Company of Los Angeles, California. By 7 July 1940 the work, amounting to a little over a mile in total, was complete.[2] Almost effortlessly, the small city of Chehalis, located less than a mile to the east of the river at this point, acquired a new bridge and road as the result of the state's highway building program.

The bridge, a 240' steel truss complete with treated timber trestle approaches, was an integral part of the routing of a section of primary U.S. Route 12--the Ocean Beach Highway--in this vicinity. In the previous year the Department of Highways had begun improvements on this road eastward from the Pacific County line to Chehalis, a distance of some twenty-six miles.[3] The final section of this road however, now called Riverside Road, was extremely circuitous, curving eastward with the meandering of the river, crossing this via an old truss bridge, circumventing the western boundary of the town, before finally entering from the north. Probably because of the indirectness of this last stretch of road, it was decided to build a new section straight into the heart of the city. Whereas the line of this earlier road had been dictated in part by the need to avoid the extensive flood plane of the river, which had limited the location of the bridge to a less challenging yet more out of the way location, the new bridge with its massive concrete piers and very long trestle approach demonstrated mastery over the frequent threat of flooding.

The old Chehalis River Riverside Bridge, a 220', 11 panel, pin connected Pratt steel truss with timber frame approaches, was in any case probably deemed unable to cope with the anticipated traffic demands of a new major highway. The timber deck was only 18' wide, and this had been replaced twice before in the space of four years: in 1918 a new deck was added, and in 1922 a new deck and new stringers were installed. It was built by the county in 1914 to replace a 180', 11 panel, combination pin connected span, with a 16' roadway. This was built in 1893, or even earlier. The Ambrose Burdstall Company of Portland were the contractors for the 1914 bridge, and the materials were fabricated by the Coast Bridge Company.[4]

At some point in the 1920s the state acquired ownership of the bridge, when Riverside Road formed part of a another state highway. In 1941, after the construction of the new bridge, the state returned ownership and responsibility to the county. The following year, the bridge became the joint responsibility of the county and the City of Chehalis. For some years, Chehalis was able to enjoy the flexibility of having two vehicular bridges in the Riverside vicinity, to the West of the city. In the recent past however, probably because of maintenance problems, the older bridge has been serving pedestrians and cyclists only. Today it is closed completely.[5]

Design and Description

The Chehalis River Riverside Bridge consists of one 240' steel riveted through Warren truss with verticals, one 39-span treated timber trestle and one 3-span treated timber trestle which flank the main span to the north-east and south-west respectively, giving an overall length of 1,045'.[6] The main span, consisting of eight 30' panel lengths, is supported at either end by reinforced concrete wing piers, each standing 50' high and cast with massive 15' diameter footings. Both penetrate the majority of their length into the soft, sandy clay that makes up the river banks. Because the river here is at low grade and prone to flooding, adequate clearance above high water level was a critical element in the design of the substructure. The height of the bottom chord of the bridge above the normal water level is 29'; however, above the recorded high water level of December 1937 it would have cleared by only four feet. The connection between the ends of the lower chord and the north and south pier tops is, respectively, formed by a cast-steel shoe with a 6" diameter pin, and a cast-steel rocker. The former resists the lateral thrust of the structure caused by expansion, while the latter is designed to accommodate it.[7]

The upper chord, a polygonal curve in elevation, is made up eight composite members, each fabricated from two 21" wide cover plates riveted to the outer sides of the flanges of two 15" web channels. The upper plate is 7/16" thick in section and solid, whereas the lower plate is 3/8" thick and punched. This is because the entire upper chord is in compression: since the compressive forces are especially concentrated in the top flange of the members forming this, a thicker, solid top plate is required. Also, a solid upper plate prevents direct water penetration into the member. The lower chord, which acts in tension, is built up in an identical fashion, except that both top and bottom cover plates are 7/16" thick in section.

The diagonal members connecting the top and bottom chord carry both compressive and tensile forces. They are similarly formed to the upper chord members, but are more slender in both cross section and thickness of plate: the web of both channels is 12";

and the plates, also 12" wide, are 5/16" thick. Because less steel was used, a significant saving in both weight and cost of materials was achieved, both of which were important factors in bridge design. The use of punched plates in these members further enhanced such economies.

The vertical members, also connecting the upper and lower chord, carry only tensile forces. Their function is to serve as bracing for the triangular web system formed by the diagonals. Each is composed of four angles measuring 5" x 3", riveted to a 12" wide solid plate, thus forming a composite I section column. The steel used for both is 5/16" thick. They are jointed laterally by struts which are similarly composed of four angles and a plate.

The top lateral bracing members are made up of two angles, 4" x 3" x 5/16", riveted to one 15"-wide plate of the same thickness. The whole structure is also thoroughly sway braced by a trussed arrangement of 8" x 8" I-beams converging to the mid point of a shallow curved member between each post, which is built up in an identical fashion to the verticals throughout the truss. The portal bracing arrangement is similar to this, although the actual members, apart from the curved one, are built up differently. The portal strut is made up of two parallel channels, their flanges facing, riveted together with batten plates, thus forming an open member. The three other members are all I-section, formed from three angles and a plate. The employment of a curved lower member in both the sway and portal bracing provides additional rigidity, because of the thrusting action of the arch to the verticals and inclined end posts respectively. The position of this member is such that it provides a minimum of 15' of clearance from the roadway. Throughout the truss superstructure, all panel points are connected with steel gusset plates.

The bottom lateral bracing members are built up of two angles, riveted together, each measuring 4" x 3-1/2". The thickness of steel used for these angles varies across the length of the bridge. In the outermost panels, (L0-L1 & L7-L), where stresses are most acute, the steel used is 1/2" thick. Moving inward, where the stresses are more dispersed, the steel is thinner: between L1 and L2, and L6 and L7 it is 3/8" thick; for the inner four it is 5/16" thick. Two braces, intersecting at their mid-point, are used within each panel. Nine I-section steel floor beams, 33" x 11-1/2", made up of four angles and a plate, support five lines of similarly built stringers, 24" x 9", spaced 5'-9" apart. On top of this is 5-1/4" thick concrete deck, reinforced by two layers of 1/2" thick steel reinforcing bar, spaced 5" apart. On the south east elevation, cantilever brackets extend out from the lower chord to support a 3'-6" concrete sidewalk complete with steel lattice railing. The concrete roadway itself is 24' wide between curbs.

The concrete decked approach to the northeast of the main span is supported by a 39-span treated timber trestle made up of five-pile framed bents. The total length of these spans is 742', they were required to cross the Chehalis River flood plain which in this vicinity extends mostly on the west side of the river. A concrete balustrade flanks the roadway on both of these spans, and the 58' treated timber trestle approach spans to the southwest. On either end of both sets of balustrades are two a concrete panels bearing art deco detailing in the form of three parallel, vertically incised lines. Two of these, at the start of either approach, have "1939" stamped into them also, thus forming a "Standard Date Panel".[8]

The bridge is significant in terms of the evolution of truss bridge technology. In the early twentieth century, two truss types, the Pratt and the Warren, emerged as the most successful of all competitors in this class of bridge. Their demonstrated versatility, durability and economic superiority ensured that virtually all truss bridges in this period were variations on these two basic forms. Both types were invented in the 1840's, but it was not until the end of the century that their inherent qualities, greatly suited to the growing trend towards uniformity and standardization in the American construction industry, were realized. The Warren truss in particular elicited further attention in the early twentieth century when it displayed its adaptability to new techniques of riveting.[9]

The major change in the design of both types in this century was a tendency towards rationalization and simplification. One manifestation of this in the Warren form was the exclusive use of rigid diagonal members throughout the truss. Up until the first decade of the century, diagonals serving as tension members were frequently formed by thin eyebars. Under increasingly heavy highway loadings however, these proved susceptible to collapse, and so their use diminished and finally discontinued.[10]

The Chehalis River Riverside Bridge incorporates many design features that separate it from earlier Warren types. These include polygonal upper chords; distinctive portal and sway bracing with curved lower members; employment of punched plates in the built up structural members, and riveted construction throughout. Such elements combined to produce a sturdy, reliable and economical bridge was ideally suited to a variety of situations where moderately long spans were called for. Indeed, the bridge was built from a "standard" Department of Highways design which allowed the virtual mass production of this form of bridge.[11]

The Cora Bridge over the Cowlitz River, also in Lewis County is an almost exact duplicate of this structure.[12] Built in 1947 by the state, the steel superstructure of this 240' Warren truss with verticals is identical in every respect apart from a slight modification to the portal and sway bracing. In this, five as opposed to three diagonals are used between the top strut and the arched member to provide even more rigidity to the whole structure. Nevertheless, such a relatively minor change over a seven year period is testimony to the basic soundness of both the Highway Department's original design, itself a variation of the original Warren design.

The bridge is flanked on either side by concrete approaches which rest on tall concrete piers. Significantly, there is a great discrepancy in the length of these approaches; the longer one, like that of the Chehalis River Bridge, providing necessary clearance over the flood plain of the river. The number of other bridges in the state following this standard design is not known, but both these examples show its adaptability to low-lying, frequently flooded sites. In both these situations, the standard 240' span is fixed on concrete piers over the main channel, while one of the approach spans is used to traverse the flood plain. [13]

<u>Repair and Maintenance</u>

From the first available inspection report of 1947, it would appear that the steel truss section of the bridge has remained in good overall condition. Structurally, the steelwork remains generally sound to this day, and it has not required replacement of individual members since it was built. Aside from such routine tasks as the re-painting of the truss and railing, the major problems requiring repair that have arisen relate to the concrete deck, the concrete balustrade and the treated timber trestle.[14]

By 1948 it was noted that insufficient asphalt between the concrete deck joints was permitting water to penetrate, causing isolated patches of rust to develop on the flanges of the floor beams and in the joints of the bottom chord. It was recommended that tar be poured between the joints to seal them and hence arrest the rusting process. This was presumably undertaken by the following year, for from then until 1964, when the problem was noted again, the deck was reported to be in good condition. The joints were sealed on two further occasions, in 1967 and again in 1985.

In 1955 it was first observed that the north baluster on the west approach had suffered a small collision, which had knocked out a piece of concrete and exposed some 2" of reinforcing bar. By 1966, because of spalling, the area of damage had spread markedly, exposing some 18" of steel on the inside of the baluster, and the problem was noted as requiring attention. In 1970 it was repaired.

The treated timber trestle approaches survived well for almost three decades before it was noted that some of the piles were cracked and developing center rot. In 1969 three piles on the south approach were drilled and plugged, determining that they had developed center rot. The problem was not confined however to these three; subsequent inspections showed that a significant number of piles had center rot, and many of the caps had developed rot. By 1974 the replacement cost was estimated at $250,000, this removed it from the realm of both state force work and a district level contract. [15] The scope of work was thus turned over to the Plans and Contracts Division of the Department of Highway's Roadway Development section, but at this time the project has not been funded. The problems with rotten and cracking piers are recorded as worsening in September 1991, the last inspection report. The 1988 Bridge Inspection Report mentioned the estimated life expectancy of the trestle as 1996.[16]

Data Limitations

This bridge received no coverage in the engineering literature. The *Engineering Index* made no mention of it, while a perusal through the two more regional engineering journals, the *Pacific Builder and Engineer* and *Western Construction News* for the year 1939, yielded only limited contractual information from the former (see bibliography). These journals are available for immediate consultation in the Seattle Public Library.

With regard to construction of the historical context of the bridge, the Department of Highways *Biennial Report* provided some useful information. Other than one newspaper citation to the old (1914) Chehalis Riverside Bridge found via the card index of the Washington State Library's Northwest Room, in Olympia. No newspaper article citations were found in the card indexes of either the Washington State Historical Society, Tacoma, or the Lewis County Historical Society, Chehalis.

The (incomplete) set of plans held on microfilm at Records Control, Washington State Department of Transportation, Olympia, Washington, together with the information held on the "Kardex" file at the Bridge Preservation Section, Olympia, proved particularly useful in describing the structure.

Project Information

This project is part of the Historic American Engineering Record (HAER), National Park Service. It is a long-range program to document historically significant engineering and industrial works in the United States. The Washington State Historic Bridges Recording Project was co-sponsored in 1993 by HAER, the Washington State Department of Transportation (WSDOT), and the Washington State Office of Archeology & Historic Preservation. Fieldwork, measured drawings, historical reports, and photographs were prepared under the general direction of Robert J. Kapsch, Ph.D., Chief, HABS/HAER; Eric N. DeLony, Chief and Principal Architect, HAER; and Dean Herrin, Ph.D., HAER Staff Historian.

The recording team consisted of Karl W. Stumpf, Supervisory Architect (University of Illinois at Urbana-Champaign); Robert W. Hadlow, Ph.D., Supervisory Historian (Washington State University); Vivian Chi (University of Maryland); Erin M. Doherty (Miami University), Catherine I. Kudlik (The Catholic University of America), and Wolfgang G. Mayr (U.S./International Council on Monuments and Sites/Technical University of Vienna), Architectural Technicians; Jonathan Clarke (ICOMOS/Ironbridge Institute, England) and Wm. Michael Lawrence (University of Illinois at Urbana-Champaign), Historians; and Jet Lowe (Washington, D.C.), HAER Photographer.

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[Soderberg, Lisa] "HAER Bridge Inventory--Riverside Bridge." Held by Washington State Office for Archaeology and Historic Preservation., Olympia, WA. June 1979.

Washington. Department of Highways. *Eighteenth Biennial Report of the Director of Highways, 1938-1940*.

Miscellaneous:

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"Primary State Highway No. 5 Cora Bridge and Approaches, Lewis County." Contract No. 3348. August 25 1947. Records Control, WSDOT.

"Standard 240 Foot Steel Truss, Concrete Deck, 24 Foot Roadway & 3-6 Sidewalk, Stress Sheet. [Plan and Elevation Drawing]." Approved 17 April 1937. Records Control, WSDOT.

Washington. State Department of Transportation. Bridge Preservation Section. Bridge Files.

ENDNOTES

[1] Lacey V. Murrow, "Wn, Olympia--State Bridge ($250,000) [Notice of impending bids]," *Pacific Builder and Engineer*, 25 January 1939, 8.

[2] Washington Department of Highways, *Eighteenth Biennial Report of the Director of Highways, 1938-1940*, 175.

[3] Ibid., table nos. 34-37.

[4] [Lisa Soderberg] "HAER Bridge Inventory--Riverside Bridge," held by Washington State Office of Archaeology and Historic Preservation, Olympia, WA; "Chehalis River Bridge Shows Long History, Ownership Shift," *Chehalis Advocate*, 5 January 1956, 1.

[5] Ibid.

[6] "Riverside Bridge, No. 6/123," Kardex Card File, Bridge Preservation Section, WSDOT; "HAER Inventory--Riverside Bridge."

[7] "Primary State Highway No. 12 Riverside Bridge and Approaches Across the Chehalis River, Lewis County [Plan and Elevation Drawing]." Contract No. 2538, sheet 4 of 20, approved 12 June 1938, held by Records Control, WSDOT.

[8] "Primary State Highway No. 12 Riverside Bridge and Approaches Across the Chehalis River, Lewis County [Plan and Elevation Drawing]," sheet 4 of 20; "Standard 240 Foot Steel Truss, Concrete Deck, 24 Foot Roadway & 3-6 Sidewalk, Stress Sheet, [Plan and Elevation Drawing]," approved 17 April 1937, held by Records Control, WSDOT; "Riverside Bridge, No. 6/123," Kardex Card File, Bridge Preservation Section, WSDOT.

[9] T. Allen Comp, and Donald C. Jackson, *Bridge Truss Types: A Guide to Dating and Identifying*, Technical Leaflet Series, No. 95 (Nashville: American Association for State and Local History, 1977) n.p.; Carl W. Condit, *American Building Art: The 20th Century* (New York: Oxford University Press, 1961), 82-87; Donald C. Jackson, *Great American Bridges and Dams* (Washington: The Preservation

Press, 1988), 24-30.

[10] Condit, *American Building Art: The 20th Century*, 82-87; Comp and Jackson, *Bridge Truss Types*, n.p.

[11] "Standard 240 Foot Steel Truss, Concrete Deck, 24 Foot Roadway & 3-6 Sidewalk, Stress Sheet. [Plan and Elevation Drawing]."

[12] This bridge was seen by chance while travelling to another structure.

[13] "Primary State Highway No. 5 Cora Bridge and Approaches, Lewis County [Plan and Section Drawing--East Approach]," contract no. 3348, sheet 4 of 13, 25 August 1947, held by Records Control, WSDOT; "Primary State Highway No. 12 Riverside Bridge and Approaches Across the Chehalis River, Lewis County [Plan and Elevation Drawing]."

[14] "Riverside Bridge, No. 6/123," Bridge Inspection Reports (1947-91), in Correspondence Files, Bridge Preservation Section, WSDOT.

[15] R. L. Carroll and P. C. Henrichsen to C. S. Gloyd, Vancouver, Washington, 10 June 1974, in "Riverside Bridge, No. 6/123," Correspondence Files, Bridge Preservation Section, WSDOT.

[16] "Riverside Bridge, No. 6/123," Bridge Inspection Reports (1947-91).